

TECHNICAL MEMORANDUM

ON

CONTROLLED SURCHARGE OF

LAKE OROVILLE

FOR

ADDITIONAL FLOOD CONTROL

YUBA-FEATHER SUPPLEMENTAL FLOOD CONTROL PROJECT (COSTA-MACHADO WATER ACT OF 2000)

YUBA COUNTY WATER AGENCY

AUGUST 2002

SECTION I

The Yuba County Water Agency (Agency) is conducting a feasibility study of potential elements of the Yuba-Feather Supplemental Flood Control Project (Y-FSFCP) with a grant from the Costa-Machado Water Act of 2000. The grant is administered by the California Department of Water Resources (DWR). Flood control elements of the Y-FSFCP will be increments of the broader flood control program of the Agency. Previous studies by the Agency show that the full flood control objective of the Agency cannot be met with funding anticipated under the Water Act of 2000. Therefore, the Agency is including in the feasibility study those flood control elements that will be most effective for flood control and that can be implemented with anticipated funding. Some elements that could be undertaken independently by DWR can provide additional increments of the Agency's flood control objective.

FLOOD CONTROL PROGRAM OF THE AGENCY

The Agency was created by a special act of the California Legislature in 1959 to primarily address flood control and water shortage issues in Yuba County. A local bond issue was passed by a margin of 11 to 1 (92 percent) in 1961 to finance construction of the Yuba River Development Project. New Bullards Bar Dam and Reservoir on the North Yuba River, the cornerstone of the Project, was placed in operation in 1970. It provides 170,000 acre-feet (af) of dedicated flood control storage, and water for downstream needs and power generation at Colgate Powerhouse and Narrows II Powerhouse at Englebright Dam. Federal funds were appropriated to assist in flood control costs and State of California bond funds assisted in development of recreation facilities at New Bullards Bar Reservoir.

During the time of implementation of the Yuba River Development Project, it was anticipated that Marysville Dam and Reservoir would also be constructed and provide flood control for runoff from the entire Yuba River watershed. Subsequent studies by the Corps of Engineers (Corps) led to Congressional authorization to construct a dam at Parks Bar with 240,000 acre-feet of dedicated flood storage. However, its construction is unlikely as long as spring run salmon and steelhead in the Yuba River are listed as endangered species. Consequently, only the 170,000 af of dedicated storage in New Bullards Bar Reservoir and the incidental, but important, nearly 15,000 af of surcharge flood storage in Englebright Reservoir, can be used to regulate flood flows in the Lower Yuba River.

The Agency has focused its efforts on examining all alternatives for incremental flood control, including providing the local cost share for levee improvements authorized and

constructed pursuant to studies by the U.S. Corps of Engineers (Corps). In 1997, the Agency initiated studies of supplemental flood control measures.

PHASED SUPPLEMENTAL FLOOD CONTROL PROGRAM

Studies initiated in 1997 led to adoption in 1998 by the Agency Board of a seven-phase program leading to implementation of measures to provide protection against flood events with a 10-percent chance of occurrence in 50 years or a 1:500-year event. Phase II studies, *Formulation and Analyses of Alternatives for Supplemental Flood Control on the Yuba River*, were completed and accepted by the Board in 2001. While Phase II studies were underway, the State Legislature enacted Senate Bill 496 in 1999, which added the South Yuba River to the California Wild and Scenic River System, and the Costa-Machado Water Act of 2000. In addition, the Corps recalculated flood storm characteristics for the Yuba Feather System. Consequently, the originally planned phased study/implementation program required revisions.

COSTA-MACHADO WATER ACT OF 2000

The Water Act of 2000 includes provisions for financing a portion of the flood control measures needed to meet the Agency's objective level of flood protection. It provides up to \$70 million for the Yuba-Feather Flood Protection Program, including projects along the Colusa Drain and its tributaries, to be implemented by a local agency, and for the costs of administration by the State of California (State). It also provides for up to \$20 million for mitigation of environmental impacts of flood control measures. Although the Water Act of 2000 calls for local cost sharing and allows for potential federal funding, the limited amount of funds will be used for measures that can most effectively provide flood control. Early implementation is also a primary objective of the Agency.

One of the potential flood control measures, called elements, that was first identified in the Phase II report, *Formulation and Analysis of Alternatives for Supplemental Flood Control on the Yuba River*, is surcharge storage in Lake Oroville, a facility of the State Water Project.

LAKE OROVILLE CONTROLLED SURCHARGE CONCEPT

Incremental and temporary storage for major floods can be developed by surcharging Lake Oroville above the elevation of the crest of the emergency spillway. Such surcharge can be created by managing the rate of releases through the gated primary spillway or by constructing segmented, collapsible gates on the crest of the emergency spillway. Crest gates were analyzed in the Agency's Phase II studies. Subsequent detailed review of established flood operating rules and flood routing studies reveal that there are provisions for surcharging to limit the release of water to not more than the downstream objective flow of 150,000 cubic feet per second (cfs) for as long as possible. The resultant surcharge of 9.7 feet above the emergency spillway would create essentially the same temporary storage and benefits as 10-foot-high crest gates evaluated in the Phase II studies. Either alternative would provide about 150,000 af of storage in addition to the 750,000 af of designated flood control storage.

OBJECTIVE OF TECHNICAL MEMORANDUM

The objective of this technical memorandum is to document the findings of studies under the Water Act of 2000 regarding the emergency operation of Lake Oroville for additional flood control and to set forth how such reoperation will be considered in the feasibility studies of the Yuba-Feather Supplemental Flood Control Project.





From: California State Water Project Atlas, June 1999

operates Lake Oroville in accordance with the post-Marysville Dam criteria. These criteria are referred to as the Existing Operation Plan in this memorandum.

EXISTING OPERATION PLAN

Lake Oroville is currently operated for flood control based on the minimum release criteria established by the Corps in 1971. The operating criteria are described on the Flood Control Diagram (FCD) and Emergency Spillway Release Diagram (ESRD) contained in the Corps of Engineers' document, *Oroville Dam and Reservoir, Feather River, California, Report on Reservoir Regulation for Flood Control*, August 1970 (Report). The diagrams provide detailed information on how the reservoir should be operated during flood periods. Key parameters for determining rates of reservoir releases under the FCD are (1) accumulated seasonal precipitation plus the current day's precipitation, (2) the amount of water stored in the flood pool, (3) forecast reservoir inflow, and (4) downstream objective release criteria. Key parameters for determining rates of reservoir releases under the ESRD are (1) the rate of rise of the reservoir during the preceding hour and (2) the amount of water stored in the flood pool. Copies of the FCD and ESRD are included in this report as Attachments 1 and 2, respectively.

Key provisions of the FCD are that Oroville Dam should release floodwater without exceeding 150,000 cfs below the dam, 180,000 cfs in the Feather River upstream of the Yuba River or 300,000 cfs in the Feather River downstream from the Yuba River. The ESRD provides operation criteria for floods that could cause the lake to fill above its normal full pool elevation of 900 ft msl. Releases under criteria of the ESRD are primarily for the purpose of limiting the height of the water behind Oroville Dam and not for the purpose of providing flood protection downstream. Ultimately the ESRD protects the dam from overtopping failure due to an extraordinary maximum possible flood event.

Operation of Lake Oroville with criteria of the ESRD for a 1:175-year flood is shown on Figure 2. The maximum inflow is 360,000 cfs and the maximum outflow is 158,000 cfs. With downstream inflow, the total maximum flow in the Feather River below the Yuba River is 353,000 cfs or 53,000 cfs greater than the objective flow. The decrease in rate of lake outflow beginning at hour 132 is required to allow passage of the peak flow from the Yuba River. The rate of release would be increased at about hour 158. The reservoir level would reach about 902 feet or one foot above the crest of the emergency spillway.



Figure 2 Operation of Lake Oroville with Emergency Spillway Release Diagram (175-year flood)

INTERIM OPERATION PLAN.

Although the official flood control operation for Lake Oroville, as described above, was promulgated in 1970, the Report stated that this operation plan was based on the assumption that Marysville Reservoir would be constructed on the Yuba River. This was an assumed condition because Marysville Dam was congressionally authorized for construction by the Corps. In addition, the Corps was developing the construction plans for the project. The Report recommended that until Marysville Dam was constructed the flood operation rules be altered to allow for the surcharge operation of Lake Oroville. The Report contained flood routings showing complete details as to how this operation should be accomplished. The essence of this surcharge operation is to suspend the use of the ESRD and to allow the lake level behind Oroville Dam to rise above the emergency spillway crest elevation 901 feet msl while outflows from the dam are regulated to maintain downstream flows to within the designated channel capacities described on the FCD. The lake level could be surcharged to approximately elevation 911 feet msl (11 feet below the top of the dam) without violating the maximum designated flows shown on the FCD. Such an operation increases the useable flood space by approximately 150,000 af or about 20 percent.

Figure 3 displays the operation of Lake Oroville under this operation for a flood of 1:175year magnitude. The rate of release is reduced beginning at hour 132 to allow passage of the peak flow of the Yuba River. The initiation of higher releases would begin at about hour 166, about eight hours later than under ESRD criteria and reach 150,000 cfs at hour 180 or 22 hours later than 158,000 cfs under ESRD criteria. The maximum outflow from Lake Oroville is 150,000 cfs. The maximum flow in the Feather River below the Yuba River (Shanghai Bend) would be 300,000 cfs, a 15 percent reduction when compared to the Existing Operation Plan. Figure 4 shows a comparison of Lake Oroville releases and flows in the Feather River under ESRD criteria and FCD criteria with surcharge.

OBSERVATIONS ON OPERATION CRITERIA

There are two potentially significant impacts from the use of the Interim Operation Plan. The first impact is that by not using the ESRD the frequency and magnitude of flows over the ungated emergency spillway at Oroville Dam would be increased. Because the area downstream from the emergency spillway crest is an unlined hillside, significant erosion of the hillside would occur. It is estimated that under the Existing Operation Plan the emergency spillway would overflow about once every 175 years on average. With the Interim Operation Plan, the emergency spillway would overtop about every 150 years on





Figure 4 Lake Oroville Releases and Feather River Flows under Emergency Spillway Release

SECTION IV

IMPACTS OF ALTERNATIVE OPERATIONS

There would be somewhat different downstream flood control impacts as well as on-site impacts of the alternatives for securing additional flood control storage by surcharging Lake Oroville.

FLOOD CONTROL IMPACTS

Flood control impacts with operations criteria under the Existing Operations Plan and the Interim Operations Plan are described in Section II. Flood releases with crest gates would be the same as for the Interim Plan. Comparative flows and surcharge above the elevation of the emergency spillway (901 feet) for a 1:175-year flood with a maximum inflow to Lake Oroville of 360,000 cfs are shown in the following tabulation.

Alternative	Oroville Release (cfs)	Feather River below Yuba River (cfs)	Lake Oroville Surcharge (acre-feet)
Existing Operations Plan	158,000	353,000	None
Interim Operations Plan	150,000	300,000	150,000
Crest Gates	150,000	300,000	150,000

The difference of 53,000 cfs in peak flow in the Feather River between the Existing Operations Plan and the Interim Operation Plan and Crest Gates is largely attributable to the delay of about 18 hours when high releases must again be made at Lake Oroville (see Figure 4). This delay allows time for passing high flows from the Yuba River.

Either the Interim Operation Plan or the crest gates plan would increase the ability to control downstream flows to within design flow capacity. Under the Existing Operation Plan, the downstream design flows would be exceeded for floods larger than the 150-year flood. The surcharge operation of Lake Oroville by either the Interim Operation Plan or the crest gates plan would reduce this flood risk to floods larger than the 175-year flood, or about 15 percent reduction in the risk of exceeding downstream levee design flows. There is also a 15 percent increase in the risk of the lake elevation exceeding elevation 901 feet msl. This exceedance could be controlled by crest gates. The main benefit of the crest gates over the Interim Operation Plan would be the reduced spills over the emergency spillway crest. The

crest gates would allow spill over the emergency spillway every 180 years on average, an improvement over the Existing Operation Plan where there could be spills with a 150-year flood. Finally, the crest gates and the Interim Operation Plan would have the same potential impact to passing of the PMF.

CREST GATE CONSTRUCTION IMPACTS

Installation of the inflatable Obermeyer gates or rubber dams along the crest of the emergency spillway structure is expected to have minimal consequences to existing operations, access, and recreation at Lake Oroville. Environmental consequences are also expected to negligible. There is adequate area in the emergency spillway approach channel to stage construction activities, and roads to this area are adequate for all anticipated activities and equipment required for the work. The existing Ogee weir would be modified by excavation of the existing concrete to form a suitable platform for construction. It is likely that the existing crest sill in the western portion of the emergency spillway would be removed and replaced with a new concrete gravity section capable of providing the required structural stability for the gates. Some rock excavation and foundation preparation would be required for the work. Rock anchors would likely be required for the installation. Noise and dust generated from these construction activities are expected to be minimal and within a normal range for these types of activities. Construction traffic on area roads and across the crest of the dam would occur for the duration of construction anticipated to take up to eight months to complete. No road closures or other significant traffic impacts are anticipated.

LAKE RIM IMPACTS

Both the Interim Operations Plan and the crest gates plan would result in temporary higher water levels in Lake Oroville. However, there would be the potential to control the rates of release of the surcharge storage over a slightly longer period with the crest gates than under the Interim Operations Plan. There would be operating rules to empty the flood storage as quickly as possible, consistent with downstream conditions, under both plans.

Any recreation facilities in the surcharge storage zone would be flooded. Access to the boat ramps north of Oroville Dam may require traffic controls during construction.

In comments on the scoping for environmental analyses of the Yuba-Feather Supplemental Flood Control Project, the Oroville-Wyandotte Irrigation District expressed concerns regarding the impacts of water stages above elevation 900 feet msl on its Ponderosa Reservoir Dam and Miners Ranch Canal. A copy of the District's letter is included as Attachment 3.

Flood storage surcharging under either the Interim Operations Plan or the crest gate plan could cause water to back up into the wild and scenic rivers designated area on the Middle Fork, Feather River. Friends of the River, et al, have asserted that such an incursion would be violation of federal law, if it were caused by structural modification to Oroville Dam. Incursion would be acceptable under the Interim Operations Plan. Attachment 4 is a copy of the letter from Friends of the River.

EMERGENCY SPILLWAY IMPACTS

The hillside between the emergency spillway and the Feather River would be subject to severe erosion when water flows over the spillway. Depending on the rate of flow, the erodable area, as generally indicated by contours on Figure 1, could range from 50 to 70 acres. The amount of soil, rock, and debris that would fall into the Feather River could be very large, depending on the depth of erosion. There could be damages to downstream structures, including the Thermalito Diversion Dam and Powerplant, Fish Barrier Dam, and highway bridges. If there is river channel blockage below the spillway, there could be impacts on operation of Hyatt Powerplant. Additionally, erosion of 50 to 70 acres down to bare rock would have a significant adverse visual impact and effects on birds and wildlife that occupy the area.

- The flood control benefit of surcharging Lake Oroville would be the same from using the Interim Operation Plan or by adding crest gates to the emergency spillway. Either method would provide an increase in usable flood space in Lake Oroville by about 20 percent. The availability of this additional flood space reduces the risk that Feather River flows downstream from Oroville Dam would exceed levee design capacities by about 15 percent.
- 2. It has been the expectation of downstream flood managers that until Marysville Dam is constructed on the Yuba River, the Interim Operations Plan would be followed. As long as Oroville Dam is not imperiled, the flood control operation of the dam should maximize downstream flood protection. The Interim Operation Plan can be made compatible with the Probable Maximum Flood criteria with minor modifications to the existing Emergency Spillway Release Diagram.
- 3. Crest gates on the Oroville Dam emergency spillway do not require funding under the Costa-Machado Water Act of 2000 because flood control by surcharging can be provided under the Interim Operations Plan.
- 4. DWR should work with the Corps of Engineers to amend or supplement the flood operating rules to conform with the absence of Marysille Dam and to provide for modification of the Emergency Spillway Release Diagram to help operators distinguish between floods greater than 1:175-year events, and the Probable Maximum Flood to ensure the safety of Oroville Dam.
- 5. DWR should give consideration to the use of crest gates as a means of reducing the potential risk of erosion below the emergency spillway.